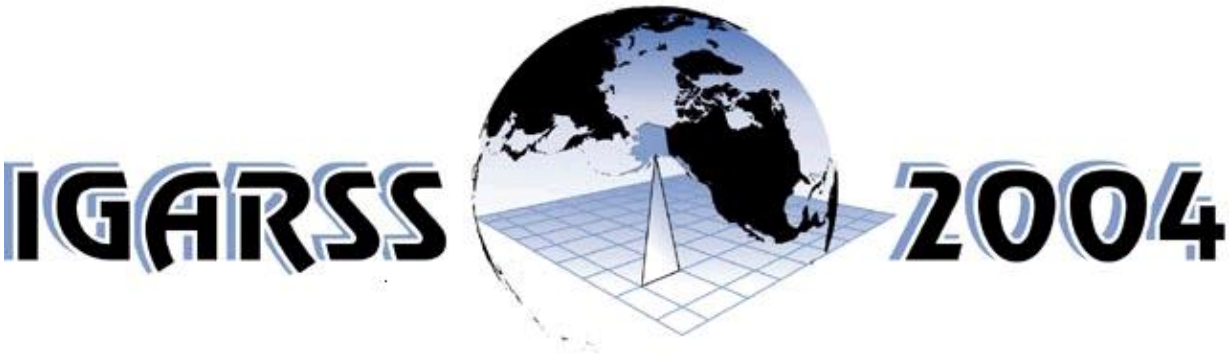

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Improved evapotranspiration estimates to aid water management practices in the Rio Grande River Basin

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Abstract

To improve the efficiency of water management and irrigation scheduling in the Rio Grande River basin, the U.S. Bureau of Reclamation helped create the Agricultural Water Resources Decision Support (AWARDS) system. Through its Evapotranspiration (ET) Toolbox interface, the AWARDS system provides guidance to local farmers on when and where to deliver water to the crops. The ET Toolbox is based on water usage estimates (evapotranspiration and open water evaporation) on a grid cell basis (4 km x 4 km). Currently, crop water use estimates are determined using a modified-Penman ET approach. To improve upon this parameterization, we use the Community Land Model (CLM2.0) within the LDAS system downscaled to a 1 km grid cell resolution. Our work aims to improve evapotranspiration and soil moisture estimates in the Rio Grande River basin through the improvement of the CLM2.0 parameterization of surface processes. We specifically intend to assimilate up to four land surface temperature (LST) observations per day from the Terra/Aqua Moderate Resolution Imaging Spectroradiometer (MODIS) instruments, at 1 km resolution, into the CLM2.0 land surface model. To verify the performance of the assimilation approach we will deploy flux towers at two different sites. We will focus our ground data collection on riparian and agricultural areas. Ultimately, our results should improve the daily forecasts of vegetation water requirements and, when integrated into operational decision support tools, aid water resource managers in making flood and drought assessments and predictions.

I. BACKGROUND

Water resources in the Rio Grande River basin are in increasing demand. Evapotranspiration from irrigated crops, riparian vegetation, and open water sources account for about 60 percent of the water depletions along the Rio Grande [1]. Consequently, there is a growing need for accurate forecasting of daily agricultural and riparian water consumption demands. To help improve the efficiency of water management and irrigation scheduling, the US Bureau of Reclamation helped create the Agricultural Water Resources Decision Support (AWARDS) system. Through its Evapotranspiration (ET) Toolbox interface, the AWARDS system provides guidance to local farmers on when and where to deliver water to the crops. The ET Toolbox estimates water usage (evapotranspiration and open water evaporation) on a grid cell basis. Based on the ET daily values, vegetation and open water Daily Consumptive Use (DCU) is generated for each hydrological rainfall analysis project (HRAP, areas of approximately 4 km x 4 km) following equation (1),

$$DCU_{total} = \frac{\left[\sum_{k=1}^{N} ET_k \frac{acres_k}{12}\right] - rain}{1.98347} \quad (1)$$

with $acres_k$ being the acreage of the surface type k of a given grid cell, and $rain$ the NEXRAD estimated daily accumulated rainfall. DCU_{total} is a flow in units of $[ft^3 \cdot s^{-1}]$. These estimates are monitored on a daily basis for the different irrigation district divisions (Fig. 1). Currently, the ET Toolbox relies on a modified Penman equation to obtain the ET estimates for each crop.

To improve upon the ET simple parameterization, we use the Community Land Model (CLM2.0) [2][3] within the Land Data Assimilation System (LDAS). The model is run at a 1 km spatial resolution to better resolve the spatial variability of ET along the Rio Grande River basin. We will develop and implement an assimilation method into CLM2.0 to better improve its surface parameterization and the model forecast capabilities. Specifically, we will assimilate satellite derived land surface temperature products using Ensemble Kalman Filter (EnKF) techniques.

These methods are tested in the state of New Mexico (Fig 2), with a particular emphasis given to the Middle Rio Grande area, extending from the Cochiti Reservoir to Elephant Butte Dam.